EVALUATION OF THREE CANDIDATE CYPERMETHRIN-PIPERONYL BUTOXIDE FORMULATIONS COMPARED WITH SCOURGE® AGAINST ADULT CULEX QUINQUEFASCIATUS

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ABSTRACT. Cypermethrin-piperonyl butoxide formulations (1:1, 1:5, 1:10) were evaluated in a laboratory wind tunnel against colony reared, susceptible adult Culex quinquefasciatus Say. Scourge® (4% resmethrin; 12% piperonyl butoxide) was used as the standard for comparison. Based on the LC50 data, the 3 cypermethrin-piperonyl butoxide formulations were 2.6-3.7x more toxic than Scourge 24-h posttreatment.

Cypermethrin, a broad spectrum synthetic pyrethroid insecticide, has proven effective in controlling adult mosquitoes (Helson and Surgeoner 1983, Roberts 1983) and Helson and Surgeoner (1986) found it to be an effective larvicide. However, cypermethrin can enhance cross-resistance in mosquitoes (Priester and Georghiou 1980).

The John A. Mulrennan, Sr. Research Laboratory (JAMSRL) laboratory wind tunnel is used to determine through bioassay and statistical analysis the efficacy of candidate insecticides, and compare the results to standard labeled insecticides. Synthetic pyrethroid insecticide formulations tested at JAMSRL have included several permethrin formulations (Floore et al. 1990), Bioresmethrin® and Esbiothrin® (Floore et al. 1992). In this study, the effectiveness of 3 cypermethrin-piperonyl butoxide (C/PB) formulations compared with Scourge® were evaluated against adult Culex quinquefasciatus Say.

Three candidate C/PB formulations (1:1, 1:5, 1:10 by volume) supplied by Clarke Mosquito Control Products, Inc., Roselle, IL, containing 47.42, 16.41 and 9% cypermethrin, respectively, were evaluated. Scourge contains a 1:3 formulation of 4% resmethrin and 12% PB and was used as a standard for comparison.

Laboratory reared 6–8 day old Cx. quinquefasciatus adults were exposed in laboratory wind tunnel tests as described by Rathburn (1969) and Floore et al. (1990). Five to 8 serial dilutions of each formulation were tested to determine the percent knockdown and 24-h posttreatment mortalities. Mortality data were corrected with Abbott’s formula (Abbott 1925). The LC50, LC90, corresponding 95% confidence limits and standard error were calculated by probit analysis. The LC50 and LC90 values were used to calculate toxicity ratios (TRr) to compare the formulation’s efficacy as follows:

\[ TR_r = \frac{LC_{50} \text{ or } LC_{90} \text{ of standard insecticide}}{LC_{50} \text{ or } LC_{90} \text{ of candidate insecticide}} \]

A toxicity ratio greater than 1 indicated that the candidate insecticide formulation was more toxic than the standard. Results were contrasted with previously published studies of permethrin, Bioresmethrin and Esbiothrin formulations using similar testing methods.

All the C/PB formulations were more effective than Scourge, the standard, against Cx. quinquefasciatus 24-h posttreatment (Table 1). The 1:5 and 1:10 C/PB formulations were 5.7x more effective than Scourge at the LC50 level and 2.9 and 3.7x respectively, more effective at the LC90 level.

The C/PB formulations were more effective against Cx. quinquefasciatus adults than permethrin/PB formulations (Floore et al. 1990). A 1:10 C/PB formulation was 3x more toxic than a 4:20 permethrin/PB formulation at the LC90 level 24-h posttreatment and 11x more effective than technical permethrin (92%). Against adult Cx. quinquefasciatus 24-h posttreatment, a 1:10 C/PB formulation was 7x more toxic than Permanone® 10EC (10% permethrin) at the LC90 level. Compared with 2% Bioresmethrin, C/PB (1:10) was 3x more toxic and 6x more toxic than 2% Esbiothrin 24-h posttreatment at the LC50 level (Floore et al. in press).

Adult mosquitoes treated with C/PB demonstrated physiological activities similar to those treated with permethrin formulations. However, there was no rapid paralysis and/or loss of legs as observed in mosquitoes treated with Esbiothrin or Bioresmethrin (Floore et al. in press). Knockdown is an important consideration in the application of synthetic pyrethroids. The highest cypermethrin dilutions demonstrated excellent knockdown capability 1-h posttreatment (>90%) and caused more than 90% mortality 24-h posttreatment. Caution must be exercised to avoid misuse of effective, broad spec-
Table 1. Laboratory adulticide tests of 3 cypermethrin/PB formulations compared to Scourge® against *Culex quinquefasciatus* 24-h posttreatment.

<table>
<thead>
<tr>
<th>Insecticide</th>
<th>Lethal concentration in mg AI/ml</th>
<th>Toxocity ratio1</th>
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<tbody>
<tr>
<td></td>
<td>LC90 95% CL</td>
<td>LC50 95% CL</td>
</tr>
<tr>
<td>Cypermethrin (1:1)</td>
<td>0.0133 0.0124–0.0143</td>
<td>0.0471 0.0413–0.0549</td>
</tr>
<tr>
<td>Cypermethrin (1:5)</td>
<td>0.0098 0.0091–0.0107</td>
<td>0.0418 0.0362–0.0497</td>
</tr>
<tr>
<td>Cypermethrin (1:10)</td>
<td>0.0099 0.0093–0.0106</td>
<td>0.0328 0.0292–0.0377</td>
</tr>
<tr>
<td>Scourge</td>
<td>0.0561 0.0537–0.0585</td>
<td>0.1222 0.1149–0.1313</td>
</tr>
</tbody>
</table>

1 = if the toxicity ratio is >1, then candidate insecticide more effective.

trum pyrethroids such as cypermethrin. In the state of Florida organophosphorus insecticide resistance has already been demonstrated (Boike et al. 1980, 1990).

In summary all the C/PB formulations were more effective than Scourge against adult *Cx. quinquefasciatus* in a laboratory wind tunnel test 24-h posttreatment. The most toxic formulation was the 1:10 cypermethrin/piperonyl butoxide.

**REFERENCES CITED**


